50000000020074

NAIC-ID(RS)T-0258-96

NATIONAL AIR INTELLIGENCE CENTER

AIR INTELLIGENCE AGENCY

SELECTED ARTICLES

NATIONAL AIR INTELLIGENCE CENTER

Approved for public release: distribution unlimited

Report Documentation Page

Report Date 04 Nov 2002	Report Type N/A	Dates Covered (from... to) -

Title and Subtitle Selected Articles	**Contract Number**
	Grant Number
	Program Element Number
Author(s)	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) Translation Services (DXLT) National Air Intelligence Center WPAFB, Ohio 45433-5648	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es)	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)
Distribution/Availability Statement Approved for public release, distribution unlimited	
Supplementary Notes	
Abstract	
Subject Terms	
Report Classification unclassified	**Classification of this page** unclassified
Classification of Abstract unclassified	**Limitation of Abstract** UU
Number of Pages 30	

NAIC- ID(RS)T-0258-96

HUMAN TRANSLATION

NAIC-ID(RS)T-0258-96 22 May 1996

MICROFICHE NR: 96C000469

SELECTED ARTICLES

English pages: 25

Source: Zhongguo Hangtian (Aerospace China), Nr. 175, November 1992; pp. 3-6; 13-15; 19

Country of origin: China
Translated by: Leo Kanner Associates
F33657-88-D-2188
Requester: NAIC/TASS/Scott D. Feairheller
Approved for public release: distribution unlimited.

THIS TRANSLATION IS A RENDITION OF THE ORIGINAL FOREIGN TEXT WITHOUT ANY ANALYTICAL OR EDITORIAL COMMENT STATEMENTS OR THEORIES ADVOCATED OR IMPLIED ARE THOSE OF THE SOURCE AND DO NOT NECESSARILY REFLECT THE POSITION OR OPINION OF THE NATIONAL AIR INTELLIGENCE CENTER.	PREPARED BY: TRANSLATION SERVICES NATIONAL AIR INTELLIGENCE CENTER WPAFB, OHIO

TABLE OF CONTENTS

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

STATUS OF UTILIZATION AND DEVELOPMENT OF SPACE RESOURCES

BY: Wang Xiji

Outer space is known as the fourth environment of mankind. In this environment there are six types of space resources as yet unexplored. These are the high positional resources of spacecraft in relation to the surface of the earth, high vacuum and clean environment resources, micro gravity environment resources on spacecraft, solar resources, ultra-low temperature heat sink resources and moon resources. This article summarizes the status of the utilization and development of these space resources.

Important terminology: Outer space, space environment, space resource, spacecraft.

I. Introduction

At the 32nd Meeting of the International Joint Commission on Aerospace in 1981, the ground, sea, atmosphere and outer space were termed the first, second, third and fourth environment of mankind. From the viewpoint of environment and resources, it was determined that around 100 kilometers was appropriate for the boundary of the outer reaches of the atmosphere, because below this altitude aerodynamics can play a major role in flight vehicle flight.

It is a giant step for mankind to enter space and to begin to adapt, study, recognize, utilize and develop the space environment. Its significance and its far-reaching effects cannot be overstated. This fourth environment which mankind has just entered possesses an extremely large amount of many different kinds of space resources. In the smallest realm of outer space within the reaches of earth's gravity and its satellites the following major categories of space resources have been discovered which can be utilized and developed:

1. High relative altitude of spacecraft to the earth's surface.

2. High vacuum and highly clean environment resources.

3. Spacecraft low gravity environmental resources.

4. Solar energy resources.

5. Ultra-low temperature heat sink resources.

6. Lunar resources.

These six major space resources are all extremely plentiful. The development of any single one of them would be of tremendous benefit to mankind. The problem facing mankind is: How to remain in space for long periods of time to study and learn about this environment and to gradually utilize and develop the various resources it possesses to enrich mankind.

Table 1. Successful space launch statistics (to end of 1990)

国别 1 / 类别 11	苏联 2	美国 3	日本 4	法国 5	欧空局 6	中国 7	其它国家组织 8	合计 9	占总数比例% 10
对地观测卫星 12	1293	513	4	8	4	14	7	1842	44.6
通信及广播卫星 13	680	189	14	7	7	5	85	988	23.9
导航定位卫星 14	159	56						215	5.21
载人航天器 15	72	69						141	3.42
其它卫星 16	457	334	34	8	17	11	80	941	22.8
总计 17	2661	1161	52	23	28	30	172	4127	100
18 占总数比例(%)	66.46	28.13	1.26	0.56	0.68	0.73	4.17	100	

1. Nation. 2. Soviet Union. 3. United States. 4. Japan. 5. France. 6. European Space Administration. 7. China. 8. Other Nations. 9. Total. 10. Percent of total. 11. Type. 12. Earth survey satellites. 13. Communications and broadcast satellites. 14. Navigation and positioning satellites. 15. Manned spacecraft. 16. Other satellites. 17 Total. 18. Percent of total.

From 1957 until the end of 1990, there were a total of 4.127 space launches of various types around the world, the specifics of which are shown in Table 1.

Earth survey satellites, communications and broadcast satellites and navigation and positioning satellites are all space vehicles which develop high position relative to the earth surface space resources. These types of space vehicles are generally also called application satellites. They have already been placed in widespread use around the world and have achieved tremendous social and economic benefits. We can see from Table 1 that application satellites are the type of space vehicle most launched by all nations. They constitute about 70 percent of all launches. We can see from this that in aerospace activities, the development of high positioned space vehicle relative to the earth surface type of resource plays a leading role.

As of the present time, high vacuum and highly clean environment resources have achieved fairly great practical results, solar power resources have achieved initial applications, and space ultra-low temperature heat sink resources have achieved little utilization. Low-gravity resource utilization and development is currently in the testing, research and possibilities stage.

As for lunar resources, it looks as if we will have to wait until a base is constructed on the moon in which man may live before appropriate scale development can be carried out. Other planet (including asteroids) resources may possibly be considered for development after the development of lunar resources.

II. Development of resources of positions of relative height above the earth surface

This space resource has been the most widely utilized and has provided the most economic and social benefit of all space resources so far. Its large scale development has turned space science and technology into an important new production force for modern society. The world-wide satellite utilization systems industry formed because of the development of this space resource

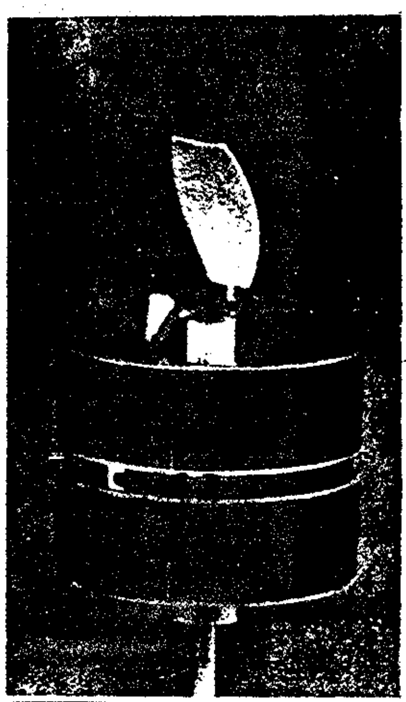
has become the primary component of the overall space industry.

The satellite utilization systems which have developed this space resource are primarily composed of satellite communications systems centered around communications satellites, satellite earth survey systems centered around earth survey satellites and satellite navigation and position systems centered around navigation and positioning satellites.

1. Satellite communications systems

Satellite communications systems are engineering systems which use the large area footprint of communications satellites which are high positioned, especially high positioned in synchronous orbit, and which relay the information.

A Chinese communications broadcast satellite



In the past 20 years, satellite communications have become an effective means of transmitting modern information. This business

has experienced an annual growth of 15 to 20 percent. It has grown 20 fold over the past 20 years. At the present time, about 80 percent of overseas voice circuits are carried by satellite communications systems. More than 170 countries make use of satellite communications systems. The services provided by satellite communications currently number more than 100 different types. These services primarily include telephone, telegraph, facsimile, data transmission, television, broadcast, electronic instruction, mobile communications (personal, vehicle, boat, and aircraft), data collection, S.O.S transmissions, publication transmissions, search and retrieval, medical, funds transmittal, communication networks, spacecraft communications, monitoring and control and data relay. Furthermore, each primary service can be divided into a number of services. For example, mobile communications can be further divided into ground, naval and air. Ground mobile communications can be further divided into personal, vehicle and train.

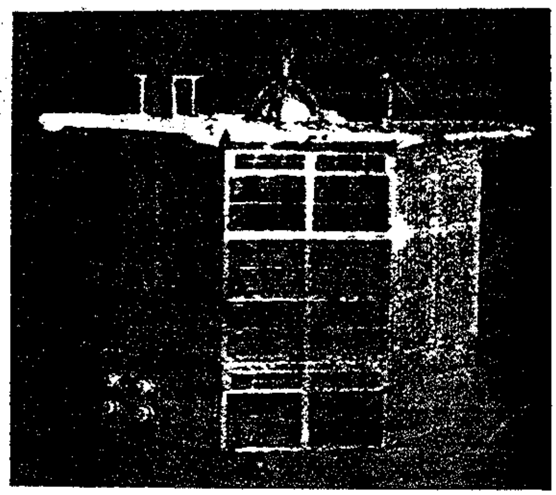
Enterprises using communications satellites in space orbit to develop high position resources have played a major role in the growth of the national economy, accelerating modernization, strengthening national defense, promoting scientific and technological advancement and improving the lives of the people. World-wide, satellite communications systems sales are several billion Dollars.

2. Development of Satellite navigation and positioning systems

Satellite navigation and positioning systems are engineering systems which use a network of navigation and positioning satellites operating in high orbit is space which can precisely measure and predict their orbital position in order to determine the positions of objects and their speed vectors. Measured points on the ground, oceans air and in space lower than the satellite's orbit receive radio navigation signals from a number (three to

four) of the navigation satellites, and using time measurement or doppler speed measuring methods, separately obtain the distance from each satellite or rate of change of distance. Based on the time each satellite sends navigation signals and their orbital parameters, it obtains the real time positional coordinates of each satellites, then it is possible to determine the geographical coordinates of the point being measured (three dimensional or two dimensional) as well as its velocity vector.

A Chinese navigation satellite

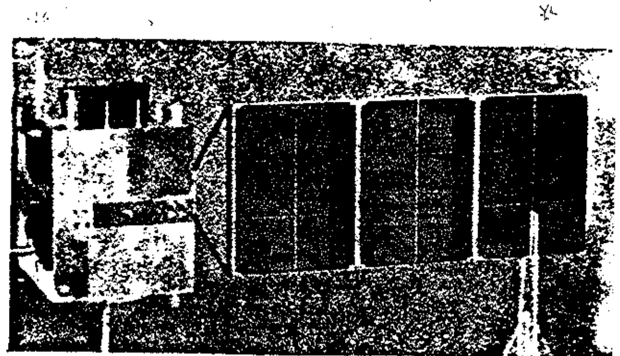


The number of moving bodies in the world (including humans) at any given time are too numerous to count. Under many circumstances such as dispatching, control, combat, ocean navigation and field operations, by knowing the position and movement vector of the object being measured, it is possible to increase efficiency several times over, and increase operations capabilities and reduce losses. Under certain conditions, precise knowledge of position and motion vector is the key factor determining success or failure. Precise positioning and navigation of large numbers of measured objects world-wide or over large land areas, oceans, air space or space would be impossible without the resources of navigation satellites positioned high in space.

3. Satellite earth survey systems

The area of the surface of the earth is more than 500 million square kilometers, more than 70 percent of which is covered by water. Using traditional measuring and observation methods to survey the earth, taking several hundred, several thousand, or tens of thousands of meters at a time, and then putting these pieces together, with common efforts around the world and using large amounts of human and material resources, the general features of the earth were finally mapped out. However, with the exception of heavily populated highly developed areas where the features were relatively clear, the surface features of other areas were only sketchy, and generally contained some omissions or even errors. Earth resources and civilization mapped out using traditional methods are in general only to be considered as static or representative of the time of the survey.

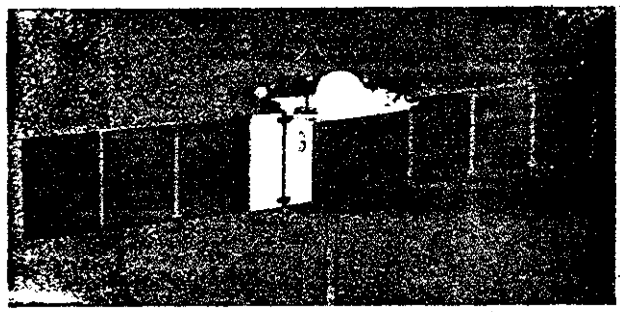
Earth resource satellite developed jointly by China and Brazil



Aerial earth surveys, because the aircraft's altitude is several thousand to several tens of thousands of meters, can cover a footprint on the surface of as much as several dozen square kilometers, a great improvement over traditional survey methods. Aerial surveys of areas which are not too large, can basically achieve rapid and dynamic surveys. However, large area or even world-wide rapid, live-time, rapid surveys are far beyond its

capability. As for atmospheric (cloud) surveys, these can be accomplished by neither traditional survey methods or aerial survey methods.

A Chinese Weather Satellite



Various types of earth survey satellites operating in high orbit relative to the surface and the atmosphere have the capability of covering several hundred, several thousand, or even hundreds of millions of square kilometers in their surveys, basically meeting the urgent requirements for large area or world-wide ground, ocean and atmospheric surveys. Satellite earth survey systems have had tremendous effects of human society, primarily manifest in the following aspects:

1), It is possible to have live time knowledge of the dynamic conditions, natural and manmade, over an entire country or region, having a firm grasp of the conditions of such resources as water, soil, minerals, forests, farming, cities and towns. This has a major influence on major national policies.

2), It is possible to survey beyond national boundaries. One country using a satellite survey system can learn of a many situations in other countries, which plays a major role in determining political, military, diplomatic and economic policy.

3), It greatly accelerates developments in meteorological

sciences, oceanology, geological sciences and agricultural sciences, thus bringing with it tremendous social benefits and economic benefits.

4), It improves forecasting, relief and prevention of natural disasters.

5), It develops world environmental sciences, allowing the earth to be studied as a planet.

Earth survey satellites, the core of satellite earth survey systems, are being developed very rapidly. There are already weather, earth resources, land, ocean and military reconnaissance and mapping satellites. Some of these satellites have already been divided into different types, for example, weather satellites include area and world-wide satellites, reconnaissance satellites include general survey, detailed survey, recoverable and transmission models.

Satellite earth survey systems which use space high positioning resources to obtain information on the earth surface and atmosphere provide services to such diverse operations as weather, agriculture and forestry, water resources, geography, geology, prospecting, mapping, oceanography, fire fighting, the environment, the military and diplomacy. Not only do they do a good job in meet all these requirements, but they also promote modernization within these departments, becoming a primary driving force for progress in society and science and technology.

III. Utilization and development of other space resources

1. Utilization of space high vacuum and highly clean resources

Space high vacuum and highly clean resources, in addition to providing a natural environment for space vehicle high speed travel

and making possible space vehicle entry into the atmosphere and long term orbiting in space, are primarily utilized to in the development of space astronomy. World-wide, the efforts to use space high vacuum and highly clean resources in the development of astronomy are second only to the efforts toward developing space relative high position to the earth surface resources.

Space vehicles carrying astronomical instruments to conduct survey and detection missions are the core components of space astronomical observation and detection systems. Astronomical observation space vehicles are capable of precise direction finding, transmission and storage of large amounts of observation and detection data. At the present time, three systems have been developed which are simply described below:

(1). Astronomical observation satellite series

This series can be further divided into solar survey satellite series and non-solar detection astronomical satellite series. The former primarily includes different earth orbit solar observation satellites, and the latter search for space radiation sources of a certain wave length or a number of wave lengths, determining their direction, intensity and radiation spectrum characteristics inside and outside the Milky Way.

(2). Lunar, planetary and interplanetary detector series

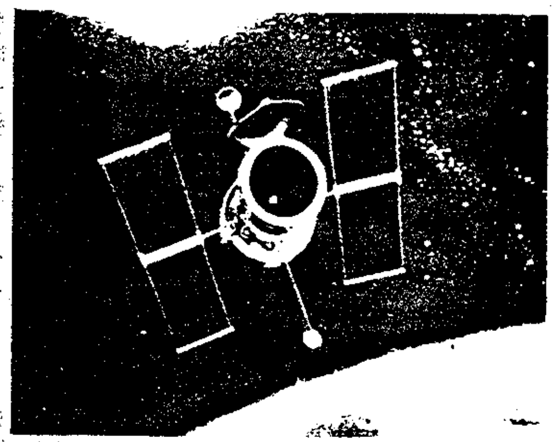
This series of detectors are space vehicles leave the earths gravitational field to the moon, planets and other bodies in the solar system and interplanetary space to collect samples or for close-up observation.

(3). Manned space station astronomical observation series

Installing astronomical observation instruments on manned

space stations not only places the astronomical instruments in space, it also invites the astronomers into space. The advantages of actually moving an astronomical observatory into space are obvious. Therefore, the United States installed the Hubbel telescope on its space lab space station. There is a special astrological survey ship on the Soviet space station Miers.

America's Hubbel telescope



Using the high vacuum and highly clean environment of space to process materials is still in the stage of experimentation and preparing necessary conditions.

2. Utilization of space solar energy resources

Up to the present time, space solar energy resource utilization is still restricted to collecting solar energy by using solar power sells of not to great surface area on space vehicle and converting this energy to electricity for use by the space vehicle. However, for space vehicle, solar power utilization has seen a great deal of development, and currently solar energy has become the primary energy source for space vehicles, with almost all long-life space vehicles using solar energy cells for their power source. Plans call for the United States "Freedom" international space station to use solar power cells to provide energy, using a

combination of solar power cells and solar power electrical generation equipment to provide energy. It will generate up to 73 kiloWatts.

The final objecting in developing solar energy resources is to establish in outer space solar energy generating stations which will convert solar energy to electricity for customers on earth. Although the solar power cells and power generating equipment on the space vehicles mentioned above use a little bit of solar energy for their own use, they cannot be considered as having developed solar energy in terms of space solar power generating stations.

There are two things standing in the way of the development of space solar power stations. The first is that the technological conditions for constructing a solar energy power station in space are still immature, especially for the construction of a solar power generating station in stationary orbit. This requires solving even more highly difficult technological problems. The second is the power transmission problem, that is, how to transmit several tens of thousands or even up to several million kiloWatts of electrical energy from space to the surface of the earth. These two major difficulties have been studied for many years, and current solutions will not be feasible without require further experience and more innovation to make them possible.

3. Space ultra-low temperature heat sink resources

Space ultra-low heat sinks are naturally occurring huge cold sources. At the present time they are only used for heat dispersion and cooling of space vehicles and for cooling instruments and equipment on board space vehicles, such as space infrared cameras, infrared spectrum scanners and infrared telescopes, which use space ultra-low temperature heat sink resources for radiation cooling.

In the future as space vehicles become more varied and larger, especially manned space vehicles, there will be additional radiation cooling requirements. In space solar energy electrical generators using thermodynamic circulation, space heat sinks will become the ideal low temperature cold source for this electrical generator's circulation medium.

COMPETITION IN THE AEROSPACE MARKET AND THE GEOSTAR SYSTEM

BY: Hu Guoli

The competition in the aerospace market is currently one of the hot spots of competition in the high science an technology marketplace. This article will introduce and analyze the causes of the bankruptcy of the American company Geostar which conducted research into space positioning technology. It will discuss experiences and lessons from that company's failures in market competition. It will also present some of the author's own views concerning the competition mechanisms of the aerospace market and future developments of the dual satellite positioning systems (Geostar system).

I. Introduction

At the present time, every production enterprise and business must find survival and growth in market competition. Competition is a challenge to businesses, but it is also the motive force for business growth. Business and production enterprises have to be able to withstand competition in order to have a future for growth. Not long ago, the well known Geostar Corporation of the United States filed for bankruptcy. This both clearly informs us how intense the competition is in the world aerospace market, and so provides us with this important information: Although a single satellite system has its advantages, in order to put it into operation as commercial product without losing any time, it is also necessary to be able to withstand the tests and trials of market competition in order to survive and to grow rapidly.

The Geostar Corporation is a privately run satellite positioning and navigation company founded in February of 1983. The company developed the Geostar system which is a well known and

influential satellite positioning and navigation system. The decision was first made to develop this system during the time of the first stage of experiments in the United States' rush for a global positioning system (GPS). Because it possessed navigation and positioning, dual directional digital cable communications and time fixing and velocity measuring capabilities, and that these operations only required two to three satellites, it had some characteristics which were different from those of GPS. Therefore, in the early eighties it was quite well known and was well received in the United States and internationally.

In the initial stages of the establishment of the Geostar company, almost everything went smoothly. The United States Federal Communications Commission arranged for a domestic frequency for its communications services and issued a permit for it to use this frequency. The International Communications League approved the extension of that frequency for world wide broadcasts. The United States Defense Department expressed its "support and encouragement for the development of this system" on a number of occasions, stating that "it can serve as a back-up for GPS". NASA reached a space systems development agreement (SSDA) with it. This agreement permitted it to "fly now, pay later" and to use the space shuttle to launch the Geostar. The governmental agencies led by the United States customer service bureau were willing finance the costs of research and development of the first batch of operational hand-held Geostar consumer equipment. Motorola arranged for production, and the experienced Sony Corporation and the Hughes Corporation undertook production of customer equipment.

All of this support and assistance actually provided the Geostar plan with a great deal of impetus and momentum. A number of countries (especially a number of developing countries) also expressed a great deal of interest, or discussed technical cooperation and the purchase of consumer equipment or desired to copy this plan in developing their own dual satellite positioning

systems.

The Geostar plan develop fairly quickly, especially at first. After the Geostar company was established in February of 1983, a satellite relay was installed on the GSTAR-11 within three months, and launched into orbit on the Ali'an (phonetic) rocket for communications channel testing. From September of 1983 to August 1984 two light aircraft were used to conduct earth synchronous satellite positioning simulation experiments. The experiments demonstrated that it could generally provide precision of several meters. Following this, the company printed a number of articles on theoretical experiments, capability evaluations and developmental outlooks (these were not published in publications). In 1986 the company received permission to launch three satellites, and launched three experimental satellites between 1986 and 1988. It also planned to launch its first operational satellite in 1992 (later put off to 1994).

Good things can't last forever, and by the end of 1990, although the company had already spent 100 million Dollars in establishing technological reserves and initial bases, financing dried up, and no investors came forward. Geostar was forced to borrow from banks, and debts grew to 80 million Dollars. On April 30, 1991, the FCC denied the Geostar company's request for an extension of time for launching satellites. Geostar had run out of resources and was forced into bankruptcy. According to the decision of the bankruptcy court, Geostar was formally bankrupt. The Geostar Reorganization Party (GRP) bought up the company's assets (primarily computers and other equipment for processing satellite data transmission), paying only 410,00 Dollars for this property, which was only around five percent of the original cost.

2. The reason for the bankruptcy and experiences and lessons

Why did Geostar go bankrupt? According to their own

statements, the primary reason was "bad luck, intense competition, and poor management." The actual situations indicates that there were also inherent technical and economic reasons and risks. These reasons or risks were interconnected and tied into one another.

A. Technical risks

As mentioned earlier, the Geostar had positioning, communications and other functions, but it cannot be denied that it had a number of technological weak points, and the technology was highly complex, so there was a fairly high technological risk.

The Geostar operated on radio distance finding principles. the overall system primarily consisted of three primary components - earth synchronous orbit satellites (two or three satellites), surface center stations and customer equipment (receivers, etc). During operations, the earth central station would send a query signal to one of the satellites, and that signal would be sent to all customers via a satellite relay. The customers could receive and respond at any time, sending out a response signal, which would be relayed to the central station by the three satellites. The central station would measure the time delay (distance) from the instant the signal was sent out until it was received. Therefore, theoretically, by using three satellites deployed every 60 degrees in space above the equator it could use distance finding to triangulate the position of a customer with a receiver. However, triangulation positioning with three satellites is geometrically not very sound, and it is difficult to improve positioning precision. It is almost impossible to accomplish near the equator. In order to obtain better positioning precision, three satellites are not generally used, but two satellites are used to determine the distance between the customer and the satellites and then using the geodetic elevation of the customers position to provide the three knowns to calculate the three dimensional coordinates of the customer's position. Because this system only used two satellites

it is commonly referred to as a dual satellite positioning system.

However, although dual satellite positioning systems result in a savings in the number of satellites (it uses 20 less satellites than the GPS system), it brings with it a series of shortcomings and problems.

(a). It is inherently insufficient and is not an integrated three dimensional positioning system. Dual satellite positioning requires the addition of geodetic elevation data to solve for the position. This requires that it be provided in advance with large area geodetic elevation data of the customers location or live time measurements of atmospheric altitude. Notwithstanding that this is very difficult and complex, even with elevation data, in areas with complex terrain it is impossible for the satellites to deliver correct positions, so its uses are restricted, especially near the equator and in high mountains where use of digital elevation to determine point position can easily generate multiple answers.

(b). In certain obscured regions it is less possible to view two satellites at the same time, and there is a greater possibility of disrupted signal than with other systems with multiple satellites (such as GPS).

(c). The central station is responsible for a large number of operations and receives a large number of signals, so in military applications it is easily destroyed by the enemy, paralyzing he entire system.

(d). This system is a two way closed system, so it requires the customer equipment to transmit an answering signal in order to determine his location. Therefore, its security features are very poor. Although it is possible to use burst type operations in order to reduce transmission time, active type transmissions are

always more easily exposed than other systems (such as GPS).

(e). Because it requires two-way communications, by comparison with other systems (such as GPS), its satellites use much more electricity, and the equipment on the satellite is more complex.

Although there are now a series of methods to compensate for or reduce the effects of these weak points, under many conditions it is still impossible to completely overcome them.

Therefore, when the Geostar was still in the initial stages of development, there were those who believed that in principle it was fairly simple and feasible, but in engineering applications "the difficulties must not be underestimated." This turned out to be the case. After the first experimental satellite was launched in March of 1986, it stopped working after only six weeks. The launch of the second satellite was postponed for a year and a half. The third satellite did not attain the desired orbit. They blamed this on "bad luck", but insiders believed that the reason for the satellite failures was not coincidence, but was due to "technological risk-taking by production departments". The payload of the satellite was developed by Astro Spacebuilt, and was monitored by experts from GTE Spacenet. Customer equipment was manufactured by Motorola and Hughes Corporation. These companies did not have a firm grasp of the technology, and not only were there problems with the equipment aboard the satellites, but there were also defects in the customer equipment.

B. Economic risks

It was estimated that the Geostar system would require 200 to 300 million Dollars in capital. About one-third of this was already collected in the early stages, and most of the remainder was continued to be collected as research and development progressed. It makes sense that since there are technological

risks, then there must be increased economic risks and investment risks.

From its very beginnings, the Geostar Corporation was faced with domestic and external competition. In the early eighties, a number of customers (especially civilian consumers) had great hopes for this system. Later, however, with the rapid development of GPS and the former Soviet Unions GLONASS global navigation and positioning systems, and with the later displaying more and more tremendous superiority in positioning theory, methods and instruments, and with its broad market, being put on the world market, and its developmental potentials, the Geostar was lost in the dust. While Geostar was suffering one failure and setback after the other, GPS was displaying excellent reliability and stability. GPS customer receivers were already better than the Geostar customer equipment in size and weight, and began to be less expensive as well. Although GPS carried out a policy of SA (selective applicability, a number of customers continued to be converted to it. Also, while the Geostar Corporation was launching three satellites to carry out experiments, no advertizing campaign was conducted about it in its early stages, in fact, no public reports were made concerning its experiments or their results. This naturally led to a number of doubts about the system. It was originally believed that by the experimental stage, customer orders would come rolling in. However, in reality, there was little increase in customers. it was originally designed for 40,000 sets, but by the end of 1990 only 4,000 sets had been sold. (GPS has already sold 100,000 sets), and Geostar was also faced with another competitor who was working with dual satellite positioning systems - Qualicom Corporation. The customer equipment produced by this Corporation was cheaper, resulting in Geostar's traditional customers switching to Qualicom. It sold 14,000 sets of customer equipment, far more than Geostar.

The number of customers determine the life of a business and

are a determining factor for investment. When Geostar was experiencing failure after failure because of its technological risks, it was also facing intense competition, and without any new calling card, the investors "lost confidence" in the system which they felt had no future. Two way telegraph communications were the Geostar systems specialty and superiority, but this superiority from just a communications standpoint was no longer attractive. Because in the middle eighties cellular communications had just emerged, and did not have many customers, but in the late eighties it spread like wildfire, with as many as one million new customers a year. By 1990 after "farsighted investors had compared the Geostar with the cellular type telephones, they refused to provide any investment capital for the former. The cellular type telephone cost 199 Dollars per set, and they could receive national services. Investors naturally asked: Why should we pay 4,000 Dollars per receiver? Is it good business to invest in such a system? Beginning in 1990, investors gave up, and the company had to close up.

C. Poor operational management

After Geostar was established, a number of presidents and agents almost all lacked a clear sense of direction in which to develop the business of the company were not of much help. For such a complex large engineering undertaking as space positioning, the company's high level managers should have done a better job in market research, and should have constantly gotten support from all aspects, and even opened up avenues for international cooperation, and in their business strategy they were always limited to within the narrow circle they designed themselves and did not sufficiently estimate nor were they sufficiently aware of the risks stated earlier. They attempted to do everything by themselves, using the limited financial resources of a single company to "peacefully" walk through the experimental stage all the way to the engineering development stage in one big successful attempt. As a result,

problems continued to appear and they lost their ability compete. They started out with a bang and then fizzled out, falling into difficult straits.

Second, the high ranking managers of this company lacked sensitivity to market competition, and were unable to adapt to market demands, make timely changes in the direction of operations and development and were not adept at devising methods of opening up domestic and foreign markets. For example, after they had lost the receiver market to Qualicomm, spread spectrum cellular communications technology was cheap and attractive and there were a large number of customers. This was their where their strength lay, but they kept on stubbornly with their original system, and allowed Qualicomm to take the lead, losing their foothold piece by piece.

Under these conditions, it is no wonder that the FCC did not allow them to use the **L** band "because of poor business management", resulting in the failure of the plan to launch the first operational model satellite, the Geostar (01) in 1994. It became impossible to proceed with the overall plan.

III. Above we have analyzed the basic reasons why Geostar went bankrupt, and experiences and lessons learned. Shortly after Geostar's bankruptcy, another company which was also developing synchronous satellite positioning, a French company, brought work to a halt on its Locstar system. We can see from this that the principle of "survival of the fittest" in the space positioning market competition cannot be ignored. In this competition, there seem to be three definite significant aspects:

A. Science and technology is the key aspect

Ability to compete in the market first of all depends on how advanced and how feasible the technology is. Even in the high S&T

field of space science, some systems are better than others and some are more advanced than others. Because there were weaknesses in the Geostar system, it could not compete with GPS. Its receivers and were not technologically superior to those of its competitors, and so they lost their ability to compete. From a comparison the American GPS and the former Soviet Union's GLONASS we can also see that the two were established at almost the same time and developed at the same pace. However, there are some differences. The GLONASS satellites are advanced enough, but the technology is not complete and the receivers are no match for those of GPS. Therefore, the overall system is not advanced, and they are on a much inferior footing in the competition.

B. Customer requirements are the basis

Customer requirements are the lifeline of business development. Without these requirements, there is no market. During the eight years from the time Geostar was established in 1983 until its bankruptcy in 1991, its customers were all gradually drawn away by other systems and companies, resulting in losses and no profits, and investors turned away, and it was inevitable that they lose in the competition.

C. Grasp opportunities to gain the advantage

In competition, timing is strength. It is a necessary conditions for gaining the advantage. Imagine that if Geostar had not had technological problems but had carried out its plan without a hitch, and it brought out its product before GPA and other systems had the entire market, then its fate would have been different. By seizing timing, it is possible to gain the edge, and even if there are certain shortcomings in technology, it is still possible to gain a portion of the market. Furthermore, there are some restrictions on civilian use of GPS, so it had a certain advantage in the civilian market. However, it has already missed

its chance.

In the year since the Geostar bankruptcy, the GRP Corporation which took it over is still wrapping up its business and maintaining its low level of daily affairs, attempting a recovery and re-establishment. However, it will not take any major steps in the short run. We have the following views concerning the future of this system.

(a). The Geostar system remains a fairly well known satellite navigation and positioning system around the world. Its technological principles and feasibility are widely accepted, although some people have raised some doubts. The bankruptcy of the Geostar company does not signify the end the dual satellite positioning system. However, as stated earlier, the inherent weaknesses of the Geostar system can still be a hindrance to its own smooth development.

(b). Although the Geostar system only requires two satellite for regional applications, it is still fairly expensive. In the experimental stage it requires almost 100 million Dollars and in the practical use stage it requires another almost 100 million Dollars or even more. After the United States GRP had purchased the assets of this company as an agent for "a small group of investors", it announced that it was only prepared to "continue to carry out operations on a fairly small scale". In the near future it is not planning to expand services or launch any new satellites. Although the United States military had originally expressed support and encouragement for this system, that was as far as it went. With the tremendous success of the GPS, the military has not further expressed support or provided any specific support. Therefore, even in the United States, at least from financial considerations, there will only be limited developments of Geostar.

(c). Future developments of Geostar will be determined, to a great

degree, by external conditions, and external competition is a serious threat to it. GPS and GLONASS are more and more attractive to the traditional customers of Geostar - civilian agencies such as transportation. These systems may be established prior to 1994. Because they lost time, they would not have been able to get into the Geostar market. If in view of the "internationalization" of GPS and GLONASS and later on restrictive policies (such as the SA policy and P code applications restrictions) were loosened, it would be easy for customers to favor GPS over Geostar, and this would have a further effect on its development.

(c). As for nations other than the United States, especially developing nations, the development to two satellite positioning systems is naturally a good way of countering the restrictive policy of the United States. This policy is primarily presumes that if "peace" is threatened or broken, the United States will close down GPS or reduce its precision. However, the United States will not necessarily do this on any given occasion. This is demonstrated by the Gulf War. Therefore, although developing countries are continuing research on this dual satellite system, it should not be felt that it is absolutely necessary to carry out plans for this system immediately. At least when the country's financial capabilities are not sufficient and the industrial technological forces are insufficient, they should not be in too much of a hurry.

it should be stated that in its operations over eight years, the Geostar company has laid down a technological basis. However, there remain a number of areas which have not been studied and which still require a great deal of further testing and research. There is not much development going on around the world on dual satellite positioning systems, so without available experience to follow and key equipment to import, for developing countries to develop such a system, in addition to the expenses, it would also require a long period of hard work.

DISTRIBUTION LIST

DISTRIBUTION DIRECT TO RECIPIENT

ORGANIZATION	MICROFICHE
B085 DIA/RTS-2FI	1
C509 BALL0C509 BALLISTIC RES LAB	1
C510 R&T LABS/AVEADCOM	1
C513 ARRADCOM	1
C535 AVRADCOM/TSARCOM	1
C539 TRASANA	1
Q592 FSTC	4
Q619 MSIC REDSTONE	1
Q008 NTIC	1
Q043 AFMIC-IS	1
E404 AEDC/DOF	1
E410 AFDTC/IN	1
E429 SD/IND	1
P005 DOE/ISA/DDI	1
1051 AFIT/LDE	1
PO90 NSA/CDB	1

Microfiche Nbr: FTD96C000469L
NAIC-ID(RS)T-0258-96